

Index

- Activities, 31–43, 45–50, 228–34
K–8, 31–43, 45–50
in counting, 45–50
secondary, 228–34
with graphs, 31–43
with trees, 35–43
- Algorithmic language, 206
- Algorithmic problem solving, 67
- Algorithms, 11, 16, 25–26, 67, 93–94, 195–206, 208–13
approximate, 93
Cralle's, 208
graph coloring, 93
greedy, 205
Euclidean, 16
retrieval, 211–13
sorting, 16, 210–11
task scheduling, 239–40
- Anagram, 12, 207–9
- Annuity problem, 153–54
- Apportionment, 7, 76
- Arms control negotiations, 226
- Array, 117
- Art, 45
- Back to basics, 68
- Basic logic, 81
- Bin packing, 72–73, 240–42
- Binomial, 143–44
- boxing match problem, 145–47
- Calculators, 178, 232–34
- Chaos, 74, 184
- Chicken, game of, 224
- Circuit, 31, 88, 94
Euler circuit, 89, 94, 238–39
Hamiltonian circuit, 89, 94, 238–39
- Combinatorics, 44, 70, 81, 137, 143
combinations, 4, 8, 59, 64–66, 70, 137, 143–46, 205
combinatorial problems, 129
inclusion/exclusion, 4, 8, 70
partition, 70
permutations, 62–64, 70, 137, 146, 205, 207
- Composition of transformations, 112
- Computer, 106, 117, 127, 145–47, 184
- Construction problem, 129
- Counting, art of, 14
problems, 129, 136, 138–42, 144–48
techniques, 18–20, 55–58, 79
with order, 45–47
without order, 47–50
- Critical path, 230–32, 239
- Crossing river problem, 52
- Defense contracts problem, 147–48
- de LaPlace, 143
- Difference equations, 5, 8, 71, 158
closed-form solution, 71
finite differences, 71
first order, 71, 160
homogeneous, 71
linear, 71, 160
recurrence equation, 71
recurrence relation, 4, 8, 16, 71
recursion, 71, 150–57
second order, 8, 162
- Directed graphs, 108, 174–76
- Discrete mathematics, 1, 67, 80
- NCTM report, 5–8
- Discrete problems, 1
counting, 2, 70, 129
existence, 1, 70, 129
optimization, 2, 70, 129
- Domino games, 129–36
- Dynamical systems, 185
- Edge, 31
- Election procedures, 7
- Enumeration problem, 129
- Equivalence classes, 209
- Euler's circuit, 89, 94, 238–39
- Euler's formula, 96–103
- Exponential growth, 154–55
- Extremization problem, 129
- Factorial function, 158–60
- Fair division problems, 7
- Finite mathematics, 68, 79–80
- FOIL, 195–98
- Four color problem, 100
- Fractals, 76, 184
- Freudenthal, 11
- Fundamental counting principle, 19, 59–62
- Fundamental theorem of arithmetic, 209

Index

- Activities, 31–43, 45–50, 228–34
K–8, 31–43, 45–50
in counting, 45–50
secondary, 228–34
with graphs, 31–43
with trees, 35–43
- Algorithmic language, 206
- Algorithmic problem solving, 67
- Algorithms, 11, 16, 25–26, 67, 93–94, 195–206, 208–13
approximate, 93
Cralle's, 208
graph coloring, 93
greedy, 205
Euclidean, 16
retrieval, 211–13
sorting, 16, 210–11
task scheduling, 239–40
- Anagram, 12, 207–9
- Annuity problem, 153–54
- Apportionment, 7, 76
- Arms control negotiations, 226
- Array, 117
- Art, 45
- Back to basics, 68
- Basic logic, 81
- Bin packing, 72–73, 240–42
- Binomial, 143–44
- boxing match problem, 145–47
- Calculators, 178, 232–34
- Chaos, 74, 184
- Chicken, game of, 224
- Circuit, 31, 88, 94
Euler circuit, 89, 94, 238–39
Hamiltonian circuit, 89, 94, 238–39
- Combinatorics, 44, 70, 81, 137, 143
combinations, 4, 8, 59, 64–66, 70, 137, 143–46, 205
combinatorial problems, 129
inclusion/exclusion, 4, 8, 70
partition, 70
permutations, 62–64, 70, 137, 146, 205, 207
- Composition of transformations, 112
- Computer, 106, 117, 127, 145–47, 184
- Construction problem, 129
- Counting, art of, 14
problems, 129, 136, 138–42, 144–48
techniques, 18–20, 55–58, 79
with order, 45–47
without order, 47–50
- Critical path, 230–32, 239
- Crossing river problem, 52
- Defense contracts problem, 147–48
- de LaPlace, 143
- Difference equations, 5, 8, 71, 158
closed-form solution, 71
finite differences, 71
first order, 71, 160
homogeneous, 71
linear, 71, 160
recurrence equation, 71
recurrence relation, 4, 8, 16, 71
recursion, 71, 150–57
second order, 8, 162
- Directed graphs, 108, 174–76
- Discrete mathematics, 1, 67, 80
- NCTM report, 5–8
- Discrete problems, 1
counting, 2, 70, 129
existence, 1, 70, 129
optimization, 2, 70, 129
- Domino games, 129–36
- Dynamical systems, 185
- Edge, 31
- Election procedures, 7
- Enumeration problem, 129
- Equivalence classes, 209
- Euler's circuit, 89, 94, 238–39
- Euler's formula, 96–103
- Exponential growth, 154–55
- Extremization problem, 129
- Factorial function, 158–60
- Fair division problems, 7
- Finite mathematics, 68, 79–80
- FOIL, 195–98
- Four color problem, 100
- Fractals, 76, 184
- Freudenthal, 11
- Fundamental counting principle, 19, 59–62
- Fundamental theorem of arithmetic, 209

- Gambler's ruin, 82, 162–65
Game, 119, 121
chicken, 224
non-zero-sum, 224–27
payoff matrix, 215
prisoner's dilemma, 225–26
saddle point, 216
value, 216
zero-sum, 214–24
Game theory, 118, 119, 120–22, 214–27
Gardner, M., 133
Gaussian elimination, 199–201
Generating functions, 143
exponential, 143
ordinary, 143
polynomial, 143
Geometric series, 181
Geometry, 16, 54, 111–14, 137
Graph, 31, 87, 96
bipartite, 95
circuit, 31, 88
clique, 88
coloring, 7, 69, 93
completeness, 88, 175
connectedness, 31, 87, 176–77
directed, 87, 108, 125, 174, 231
edge, 31, 87
isthmus, 88
loop, 87
networks, 27–29, 239
path, 31
planar, 88
simple, 88
subgraph, 88, 176
tree, 4, 91, 94, 233
triangulation of a graph, 98–99
undirected, 176
vertex, 31, 87
Graph theory, 4, 5, 7, 69–70, 118–19, 125–26, 133–36, 171, 205–6
domino problems, 133–36
Graphs, activities with, 31–43
codes, Huffman, 41–43
connectit, 32–33
constellations, 40
family "trees," 39–40
hookup, 33–34
maps, 40–41
mazes and mice, 31–32
round trips, 34–35
spanning trees, 40–41
tree diagrams, 35–37
untangling trees, 37–39
walks to school, 36–37
Group problem solving, 51–53
developing equations, 51–52
river crossing problem, 52–53
discrete math unit, 235–45
- Hamiltonian circuit, 89–91, 94
existence proof, 90–91
Newman, 90
Horner's method, 197, 203
- Induction. *See* Mathematical induction
Inductive paradigm, 196, 201–3
Inductive thinking, 23–24
Iteration, 5, 7, 8, 24–25, 178–83, 185–87
graphical analysis, 182–83, 187–88
- Julia set, 184, 192–94
filled-in Julia set, 192
- Kemeny, 78
Knapsack problem, 3, 228
Königsberg bridge problem, 89, 134
- Labor negotiations, 225
Leontief model, 8
Leslie model, 8
Linear programming, 118, 119, 122–24, 242
Loan amortization, 161–62
Logarithms, 209
Logic, 21–24
Logical deduction, 23
Logistic functions, 189–91
Logistic growth, 155
Logo, 25, 149–54
Loop invariant, 203
Lottery problem, 64–66
Lovasz, 10, 12
- MAA recommendations, 4, 128
Mandelbrot set, 184
Map coloring, 29, 100–103
Markov chains, 8, 82, 124–25
Mathematical induction, 81, 92–93, 156–57, 171–77, 203
principle, 156, 172
Mathematical modeling, 75
Matrices, 72, 104–16, 117–21
games, 72, 120–22, 214–26
graphs, 108–9
Markov chains, 72
operations, 106–8
systems of equations, 110
transformations, 111–14
trigonometry, 114–15
- Networks, 27–29, 238
New math, 68
Newton's law of cooling, 155
Newton's method, 76
Non-zero-sum game, 224–27

- Optimization problem, 122
 Orbit diagram, 190
 Order of operations, 232–34
- Pascal, 145
 Pascal's triangle, 8
 Path, 31, 87
 chain, 87
 circuit, 31
 Patterning, 24–25
 Permutations, 4, 8, 59–64, 70, 137, 146, 205, 207
- PERT methods, 7, 232
- Pigeonhole principle, 19–20, 55–58, 100
 generalized, 100
- Poincaré, 10
- Polynomial multiplication, 195, 198–99, 202
- Population growth, 160–61
- Prisoner's dilemma, game of, 225–26
- Probability, 5, 8, 16, 26–27, 143
 Probability and statistics, 81
- Ralston, 78
- Reasoning, 21–24
- Recurrence relation, 4, 8, 16, 71
- Recursion, 5, 7, 25, 71, 81, 150–57, 158, 202, 210
- Recursive paradigm, 196, 201–3
- Recursive thinking, 166–70
- Remainder theorem, 67–68
- RNA chain problem, 147
- Round robin tournament problem, 174–76
- Routing airlines problem, 176
- Sequences, 15
 Fibonacci, 8, 15
- Sequencing, 22–23
- Set theory, 20–21, 80
- Siegel, 78
- Simultaneous linear equations, 110–11, 199–201
- Six color theorem, 100
 Snell, 78
 Spreadsheet, 149, 150–54, 158–65, 179
- Sprouts, 28
 Standards, NCTM, 4–5, 128
 Strategies for games, 214
 mixed, 218
 play safe, 216
 pure, 217
- Synthetic division, 197
- Tower of Hanoi, 150–52
- Transformations, 111–14
- Traveling salesman problem, 74–75
- Tree, 4, 7, 91, 94, 233
 binary search tree, 210
 binary tree, 210–13
 expression tree, 232
 minimum spanning tree, 7, 205
 spanning tree, 176
 subtree, 210
- Tree diagram, 19, 60, 124
- USA Today* problem, 144–45
- Venn diagrams, 20–21
- Vertex, 31, 87
 adjacent, 31
 degree, 31, 87
 pendant, 88
- Voting theory, 73–74
 Arrow's theorem, 73
 Banzhaf power index, 74
 Borda count, 73
 Condorcet, 73
 majority, 73
 plurality, 73
 weighted voting, 73
- Zero-sum-game, 214–24
- Zookeeper's problem, 152

